TiO_2 evaluation on plastic surfaces as biocide agent

Final degree project
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In the last decades, the interest on new surface cleaning and disinfection processes has been arisen in the food industry. This interest comes from the need to avoid alimentary transmission diseases caused by pathogenic microorganisms in the food industry, one of the greatest concerns on nowadays health care. The stability, high catalytic performance and low toxicity, makes of titanium oxide (TiO_2) a perfect candidate for the surface cleaning and disinfection. In addition, TiO_2 can be used in an ecofriendly process that does not generate harmful sub-products during the elimination of organic, inorganic and microbial contaminants, supposing an interesting alternative to conventional methods.

Objectives

1) Establishment of a microbial growth control from the bactericide performance obtained with TiO_2.

2) Application of ISO 27447:2009 and 22196:2007 to evaluate the antimicrobial efficacy.

3) Study of the experimental conditions and optimal TiO_2 concentrations required to avoid the formation of biofilms.

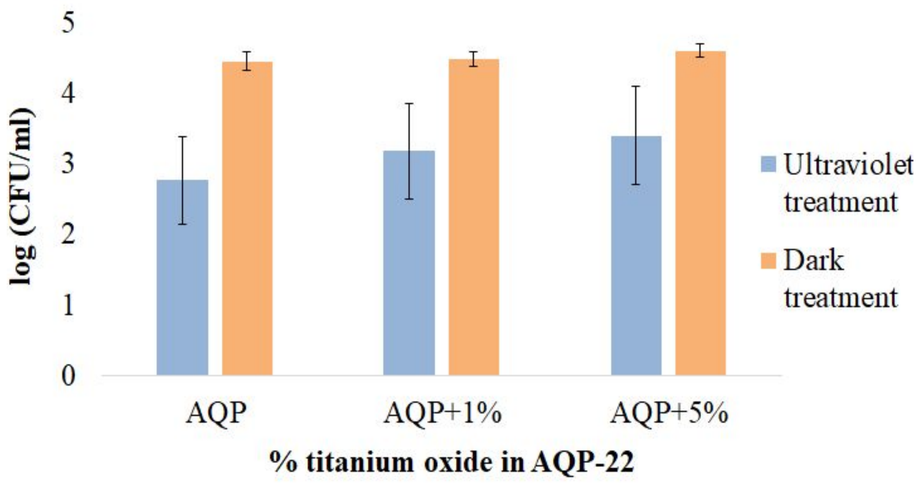
Materials and methods

- TiO_2 particles inclusion
- Inoculation of *Escherichia coli* (Film adhesion method)
- 4h UV treatment ISO 27447:2009
- 4h Dark treatment ISO 27447:2009
- analysis by TEMPO
- Calculations Film adhesion method

Results

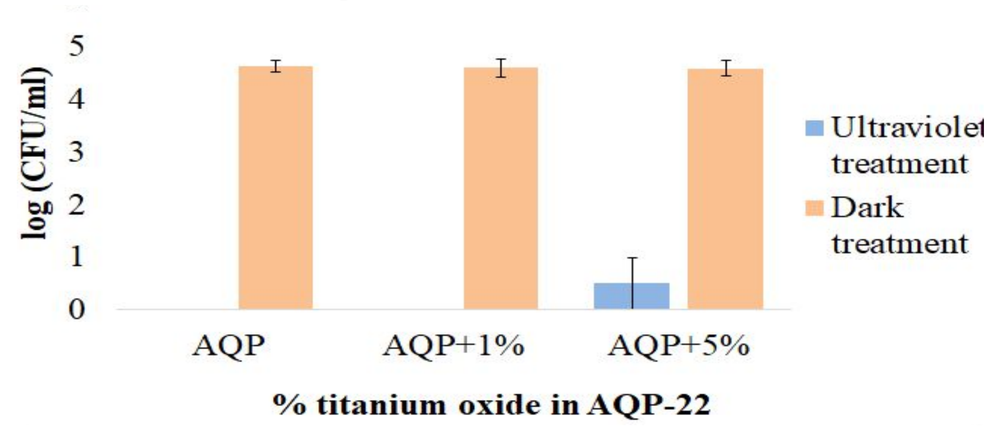
Logarithmic average CFU/ml obtained in the plastic sheet AQP-22 in dark (orange) and UV (blue) conditions, λ=364 nm.

Block A

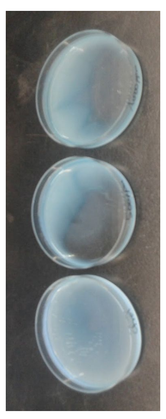


Logarithmic average CFU/ml obtained in the plastic sheet AQP-22 in dark (orange) and UV (blue) conditions, λ 254 nm.

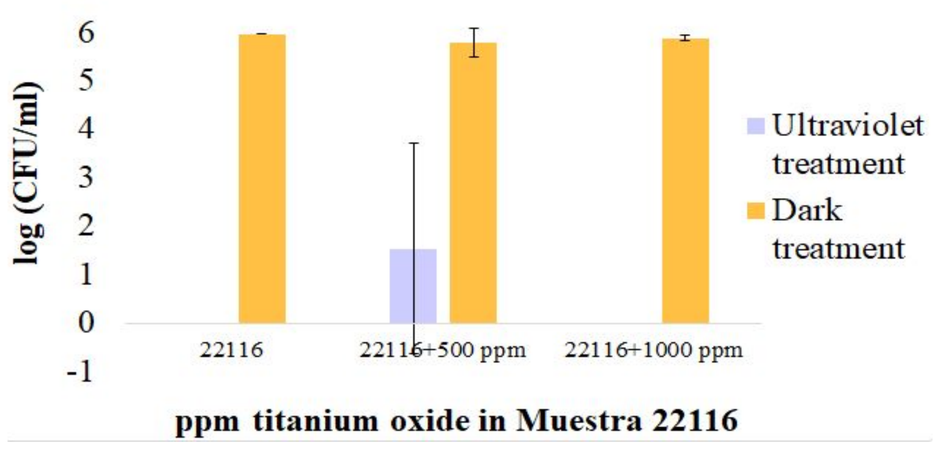
Block B



Logarithmic average of CFU/ml obtained in the plastic sheet 22116 in dark (orange) and UV (blue) light λ=364nm.



Block C



In the following plots it can be observed the UFC/ml obtaine after the dark and UV radiation treatments acording to the conditions corresponding to each block.

When the samples are treated in dark conditions, the bacterial growth is constant for the three tested conditions. Even so, a decreasing of the initial concentration is observed.

- Nutrient lack
- TiO_2 toxicity

For the UV light treatments, it is hard to distinguish among the antibactrerial activity produced by the TiO_2 and the UV radiation itself, specially in the block A and B. In B and C, the absence of proliferation in the control sample indicates that the UV is the agent acting as bactericide.

Conclusions

⇨The use of photocatalytic compounds in the surface disinfection is effective. Still, further work must be performed in the optimization of different parameters in order to improve the results.

⇨Particles inclusion method is not so effective as other methods commonly: suspended nanoparticles and nanoparticles fixed to the surface.

⇨The experimental conditions proposed by ISO 27447:2009 were optimized to avoid the sample dehydration.

⇨It is required to design an analytical method to distinguish among the bactericidal effect form the UV light and the TiO_2.

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